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Virtual Leadership in the Digital Era: A Global Bibliometric Analysis of Global Trends, Key Influencers, and Emerging Research Themes

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Abstract

Through the use of bibliometric analysis, the study seeks to highlight worldwide research patterns and future directions for virtual leadership research during the past two decades (2000–2024).The research employs bibliometric analysis to examine co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation analysis in 199 papers on virtual leadership that were extracted from the Scopus database (2 July 2024). It does this by using performance analysis and scientific mapping. The most significant authors, articles, Journals, organizations, and countries were examined. VOSviewer software was employed in the study as a performance analysis and science mapping tool. The most productive years were 2023 and 2024 with 41 publications and the most impactful institutes and countries are Binghamton University and the country is the United States, respectively. Similarly, the most influential journal is “Organizational Dynamics”, furthermore, the most cited article is “E-leadership: Implications for theory, research, and practice”. The authors also identified four thematic clusters of Research on virtual leadership, the four theme groupings are E-Leadership, Digital Leadership Capability, Sustainable Performance, and Mediated Communications. This study provides guidance for academics and details on the current status of research in the area of virtual leadership literature. It also suggests future paths of inquiry for this field of study. Through the identification of important influencers and theme clusters, this study provides a thorough bibliometric analysis of virtual leadership, contributing to a better knowledge of the subject and directing future research efforts.

Keywords: Virtual Leadership, Digital Leadership, Remote Leadership, Online Leadership, E-Leadership

Introduction

Employees who are geographically dispersed can now collaborate because of information and communication technology (ICT) (Larson & DeChurch, 2020; Alkoud & Qatamin, 2023a; Alkoud & Qatamin, 2023b; Alkoud et al., 2024; Alkoud, 2025). A new idea in leadership known as virtual leadership, or e-leadership, has emerged as a result of this occurrence (Ab Wahab et al., 2023; Alkoud, 2024). Working in virtual teams gives the organization greater flexibility and adaptability (Alkoud et al., 2023a; Alkoud et al., 2023b), enabling it to meet changing market demands and adopt a more suitable leadership style known as "virtual leadership" or "E-leadership" in this new environment (Guinalıu and Jordan, 2016; Ben Sedrine et al., 2021). The advent of COVID-19 has forced many firms to reconsider their working practices since work-from-home (WFH) has taken on a new significance. Now more than ever, the importance of virtual teams and e-leadership is being recognized (Kashive et al., 2022). Actually, relationships among collaborators through virtual communication created in cyberspace are referred to as virtual leadership (Cordova-buiza et al., 2022). Since communication and information technology are always changing, leadership roles, which are crucial components of organizational operations, must also continuously adapt to this modernization (Schultz, 2010). The concept of virtual leadership differs from traditional leadership in that it combines ever-evolving, portable technology with leadership techniques (Lee, 2009).

The novel concept in leadership, known as Electronic Leadership (e-leadership), represents a radical shift in the way a leader functions both inside and outside of the business. It is not merely an adjunct to traditional leadership. Avolio and Kahai (2003) say that in order to lead in a virtual setting, a fundamental shift in leadership is necessary, and that the role and methods for virtual leader team interaction differ from those of traditional leadership (Garcia, 2020; Butt et al.,2022). “E-leadership” or “virtual leadership” is defined as "a process of social influence mediated by advanced information and technologies producing changes in attitudes, feelings, thoughts, behavior and/or performance of individuals, groups and/or organizations" (Avolio et al., 2001b, p. 617). In addition, as per Wart et al. (2019), e-leadership is “the effective use and blending of electronic and traditional methods of communication” . Furthermore, E-leadership has been defined as “a way of leadership in which “individuals or groups are geographically dispersed and interactions are mediated by technology” (Aolio et al., 2009, p. 440).

Previous studies indicate that virtual leadership has a positive impact on the organization’s outcomes. Virtual team leaders could be extremely important, even though it is said that face-to-face synergies, physical interaction, communication, and social engagement are lost in virtual teams (Ab Wahab et al., 2023). Previous studies indicate that digital leadership has an impact on the effectiveness of virtual teams (Soon and Salamzadeh,2021; Ab Wahab et al., 2023). Moreover, Overcoming the difficulties of distant cooperation and guaranteeing team performance is largely dependent on the leadership of virtual teams (Mayer et al., 2023).

From a broader social and theoretical perspective, the growing reliance on virtual work arrangements reflects a fundamental transformation in how organizations function in the digital era. The widespread adoption of remote and hybrid work models—accelerated by global crises, technological convergence, and changing workforce expectations—has elevated virtual leadership from a temporary solution to a permanent organizational necessity.

Theoretically, this shift challenges traditional leadership assumptions rooted in physical proximity and direct supervision, and instead emphasizes digitally mediated influence, trust-building, communication richness, and adaptive leadership capabilities. As organizations increasingly depend on technology-driven coordination across geographical boundaries, understanding the evolving intellectual structure, dominant themes, and future research trajectories of virtual leadership becomes critically important for both theory development and evidence-based managerial practice.

Research Contribution

Prior research indicates that additional studies on virtual leadership are necessary. In order to fully comprehend the role of e-leadership, more research in this field is required (Van Wart et al., 2019). Avolio et al. (2014) state that since e-leadership "remains at the very nascent stage of development," a solid framework must be developed. Moreover, according to Liao (2017), there is a dearth of studies on the behaviors and processes required of a leader in a virtual team. Moreover, even though technology and digitalization have permeated every industry, many writers agree that further research is necessary to fully comprehend the E-Leadership paradigm (Butt et al., 2022). Therefore, by using bibliometric evaluation, this study provides more scientific input into the conception of global research trends and future research directions related to virtual leadership.

The present study contributes to the body of knowledge on virtual leadership in several ways. It first conducts a thorough investigation of virtual leadership. Secondly, the review is methodical and illustrates the evolution of the field's use of virtual leadership throughout time. Third, the study identifies key players in the field of virtual leadership research, including authors, institutions, publications, nations, and journals. It also identifies the key articles published in this area. Fourthly, the present study illustrates the topic clusters and epistemological underpinnings of virtual leadership.

The present study delineates the key issues in virtual leadership research that have emerged throughout the "period 2000-2024". Lastly, the current study offers potential avenues for future investigation into virtual leadership, including subjects that scholars may choose to explore in subsequent studies. By employing bibliometric analysis, the current study thus offers a further scientific contribution to the conceptualization of worldwide research trends and future research directions for virtual leadership research. in order to close the gaps in earlier studies that did not fully address this issue and to further the field of virtual leadership research.

Although research on virtual leadership has expanded rapidly in recent years, the existing literature remains fragmented and largely focused on isolated dimensions such as digital leadership capabilities, virtual team performance, and mediated communication (Karakose et al., 2021; Benitez et al., 2022; Kashive et al., 2022). There is still a clear lack of a comprehensive, up-to-date bibliometric synthesis that systematically maps global research trends, key contributors, and emerging thematic directions in this field. This study directly addresses this gap by providing a large-scale, longitudinal science-mapping analysis of virtual leadership research from 2000 to 2024.

Research Question

The current study uses a comprehensive bibliometric analysis to answer a number of virtual leadership-related research questions (RQs). This will assist in filling up the gaps left by past studies that did not thoroughly address this problem. Hence, the research that follows seeks to provide answers to the following queries.

- ***RQ1.*** *What is the current trend of research in virtual leadership?*
- ***RQ2.*** *Which are prominent authors, organisations, and countries of virtual leadership?*
- ***RQ3.*** *Which are the Most Influential Journals (MIJ) on virtual leadership?*
- ***RQ4.*** *Which are the Most Influential Articles (MIA) on virtual leadership?*
- ***RQ5.*** *What are the thematic clusters of virtual leadership?*
- ***RQ6****. What are the Influential topics in the "period of 2000–2024" in virtual leadership?*
- ***RQ7****. What are the future research directions of virtual leadership?*

Bibliometric Research Method

Defining the Appropriate Search Terms

The research delineates the standards for incorporation and exclusion of articles in a review of the literature on virtual leadership. The "Scopus" database was the source of the articles, and a search covering the years 2000–2024 was carried out on July 2, 2024. The first 457 articles that came up in the search produced names like "Virtual Leadership," "Digital Leadership," "Remote Leadership," "Online Leadership," "E-Leadership," "Virtual Team Leadership," and "Networked Leadership." The number of articles was reduced to 327 by excluding those that did not fall into the categories of "Business, Management and Accounting, Economics, Econometrics and Finance, Social Sciences, and Arts and Humanities". The number dropped to 207 when just articles were taken into account as publication kinds. Ultimately, 199 articles remained for assessment after only English-language articles were included. The extensive selection procedure guarantees the high caliber and relevance of the reviewed literature. Table 1 displays the search inclusion and exclusion criteria.

Table 1
Article inclusion and exclusion criteria

Selection criteria		**Exclude**	**Include**
Database	"Scopus"		
Date of Search	2 July 2024		
Period of Publications	2000-2024		
Search term	TITLE ("Virtual Leadership" OR "Digital Leadership" OR "Remote Leadership" OR "Online Leadership" OR "E-Leadership" OR "Virtual Team Leadership" OR "Networked Leadership")	-	457
Subject area	"Business, management and accounting, Economics, Econometrics and Finance, Social sciences and Arts and Humanities"	130	327
Publication type	" Article"	120	207
Language screening	"Include documents published in English only"	8	199

Data Collection

Since Scopus contains a sizable number of double-blind, peer-reviewed articles published in journals with high-impact factors, it was used to collect the data (Groff et al., 2020). We followed a comprehensive process to arrive at the final amount of 199 articles in Table 1. The keywords are "Virtual Leadership" or "Digital Leadership" or "Remote Leadership" or "Online Leadership" or "E-Leadership" or "Virtual Team Leadership" or "Networked Leadership"

Relying just on the extracted data without additional refining may lead to a dangerously inaccurate diagnosis. As a result, we had to go through a number of steps to organize and sanitize the data. This led us to follow the recommendations of Donthu et al. (2021) and Zupic and Cater (2015) on data visualization and interpretation as well as the search for bibliographic and bibliometric data. To improve their analysis and conclusions, the researchers removed some terms that appeared in the article's "titles, abstracts, and keywords" by using the "natural language processing" feature of the VOSviewer software. For instance, we created a lot of plural nouns. For instance, the word "organization" is created by fusing the words "organization" and "organization." Ultimately, a number of these cleaning techniques support the uniformity of topic assessment.

Selecting the Techniques for Analysis

A suite of instruments known as bibliometric analysis is used to analyse and quantify text and data using quantitative methodologies (Mishra et al., 2018; Goyal and Kumar, 2021). According to Suominen et al. (2016) and Groff et al. (2020), this strategy makes it possible to extract new data from literature studies for use in upcoming research efforts. The tasks involved in achieving this include writing and publishing biographies on topics, identifying patterns within an area of study, and assessing research papers that serve as a guide for understanding the field's current state (Gao et al., 2021; Hossain et al., 2022). The bibliometric analysis methodologies that academics employ to analyse the biographical data by Donthu et al. (2021) include authorship, citation, bibliographic coupling, co-citation, and co-word analysis.

Findings

This study employs two types of bibliometric analytic techniques: performance analysis and scientific mapping. While performance analysis largely takes into account the contributions made by research components, science mapping concentrates on the relationships between research parts (Donthu et al., 2021). The performance analysis and science mapping methods that are available will be explained in the following subsections.

Performance Analysis

Performance analysis examines the contributions that different research elements have made to a certain subject. A characteristic that sets apart bibliometric research is its descriptive analysis (Donthu et al., 2020; Donthu et al., 2021). These forms of performance will be examined in this study since performance analysis is a standard procedure in reviews that provides the performance of numerous research constituents (e.g., authors, institutions, nations, and journals).

Publication Trend

Figure 1 illustrates the publication trends in the area of virtual leadership. Preliminary research trends indicate that virtual leadership research was not previously common research in during the period (2000 to 2018), where the journey of research in this area was begun by Avolio et al. (2000) titled " E-leadership: Implications for theory, research, and practice". Followed by the study by Kissler (2001) titled “E-leadership” and the study by Lynn et al. (2001) titled “ E-leadership: tackling complex challenges”. In general, the research results also indicate that research on virtual driving in the period between 2000 and 2018 ranged between one publication and six publications, which is generally few and reflects the lack of prevalence of this type of research in the mentioned period.

Data shows that the number of publications has significantly increased over time, especially starting in 2019. There was a discernible increase beginning in 2019 (Accompanied by the spread of COVID-19), with 13 articles in 2019 and 11 in 2020, including the study by Elidjena and Rukmanac (2019), Meghana and Vijaya (2019), and Belitski and Liversage (2019) and others. With 36 publications in 2021, the number shot up sharply, peaking at 41 publications in 2022 and 2023. With 41 articles noted in 2024, the trend is expected to continue, demonstrating the field of virtual leadership's recent sustained interest and research activity. Figure 1 shows publications about virtual driving from the period 2000 to 2024 on the Scopus database conducted on 2 July 2024.

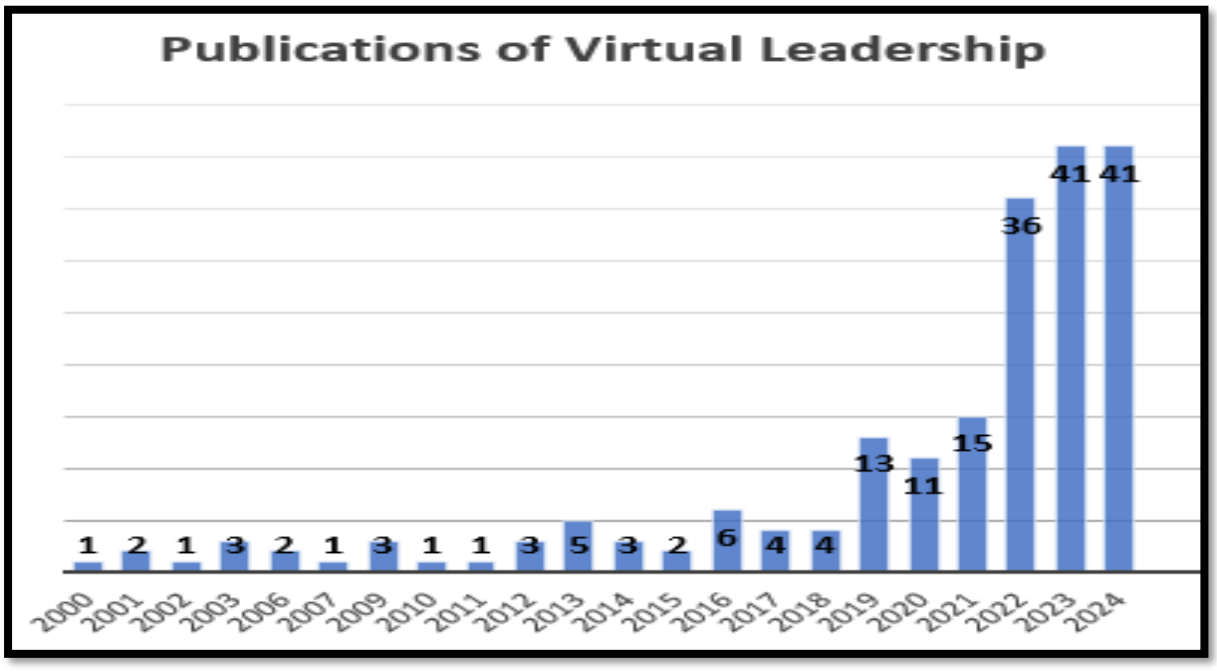

Figure 1: Publication of virtual leadership from 2000 to 2024

Prominent Authors, Organisations, and Countries of Virtual Leadership

Table 2 offers a thorough summary of well-known authors, organizations, and nations in the virtual leadership area, emphasizing their accomplishments and influence as determined by total publications (TP) and total citations (TC).

Table 2
Prominent authors, organisations, and countries of virtual leadership

Author	TP	TC	Institution	TP	TC	Country	TP	TC
Van Wart, Montgomery	6	316	Binghamton Uni. USA	1	421	United States	33	1473
Liu, Cheol	5	297	West Texas Uni. USA	1	421	United Kingdom	13	484
Wang, Xiaohu	5	297	Uni of Calgary. Canada	1	236	Hong Kong	7	380
Belitski, Maksim	2	236	Uni of Western Ontario. Canada	1	236	South Korea	9	361
Kim, Soonhee	4	177	Uni of West England. UK	1	209	Canada	7	354
Mccarthy, Alma	4	177	Uni of reading. UK	1	209	Turkey	10	332
Karakose, Turgut	3	169	Aalborg Uni. Denmark	1	208	Indonesia	30	330
Roman, Alexandru	2	160	Lego Group. Denmark	1	208	France	7	229
Papadakis, Stamatios	2	153	Uni of Southern California. USA	1	208	Greece	5	223
Polat, Hakan	2	141	Northwestern Uni. USA	2	203	China	15	211
Alamsjah, Firdaus	2	97	Uni of Crete. Greece	2	153	Spain	3	198
Sasmoko	3	79	National Uni of Ireland. Ireland	2	143	Ireland	4	177
Ready, David	2	70	IE Uni. Spain	1	134	Germany	11	170
Antonopoulou, Hera	2	65	Uni of Granada. Spain	1	134	Malaysia	14	97
Barlou, Olympia	2	65	Edhec Business School. France	1	134	India	15	96
Beligiannis, Grigorios N.	2	65	Firat Uni. Turkey	1	125	Italy	4	81
Halkiopoulos, Constantinos	2	65	Kutahya Dumlupinar Uni. Turkey	1	125	South Africa	5	61
Blau, Ina	2	60	Boston College. USA	1	120	Pakistan	9	55
Elidjen	3	50	California State Uni. USA	1	120	Australia	2	51
Curado, Carla	2	48	City Uni. Hong Kong	1	120	Cyprus	2	49

Note(s): TC = total citations, **TP** = total number of article(s) publications

Figure 2 lists the total publications (TP) and total citations (TC) of well-known authors in the virtual leadership area. Montgomery holds the top spot in Van Wart with 6 publications and 316 citations, demonstrating his considerable influence on the subject. Liu, Cheol, and Wang, Xiaohu are the next in line with 5 publications and 297 citations apiece. Mccarthy, Alma, Kim, and Soonhee Kim have each written four articles that have received 177 citations. Roman, Alexandru, with two publications and 160 citations, and Karakose, Turgut, with three publications and 169 citations, are two other noteworthy contributions. Other notable writers

with two publications and citation counts of 141 and 153, respectively, are Polat, Hakan, and Papadakis, Stamatios, who have also made significant contributions and are included in the figure. The aforementioned data highlights the noteworthy academic achievements of the aforementioned authors in the domain of virtual leadership, demonstrating their productivity and impact on research.

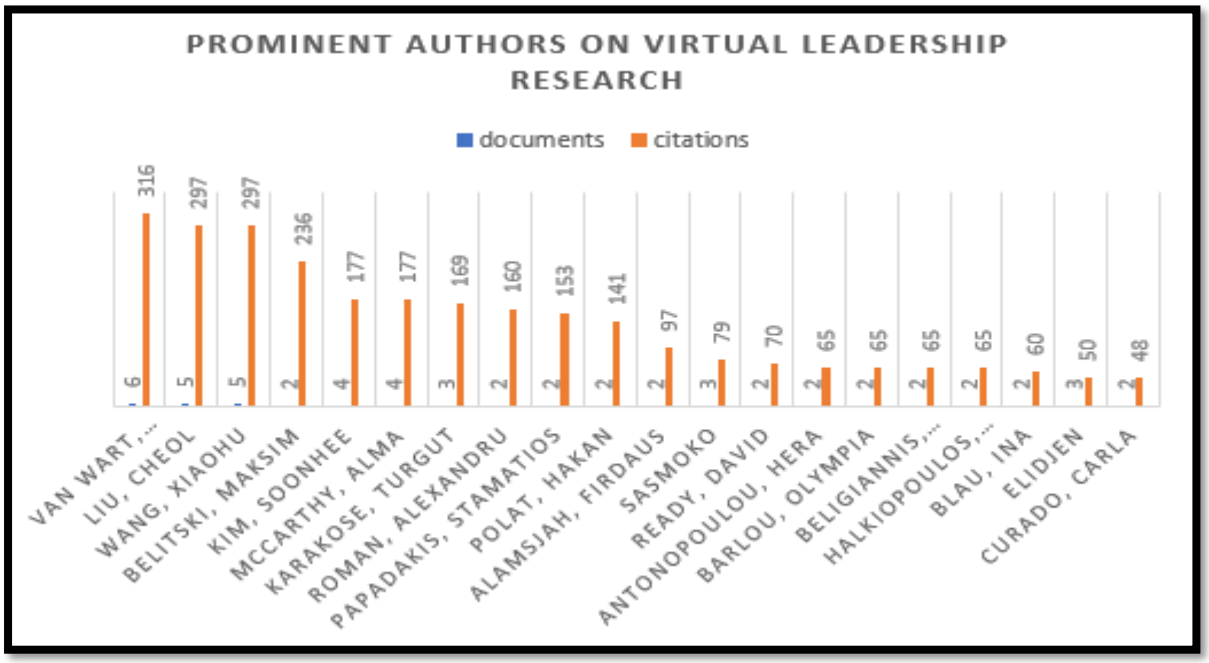

Figure 2: Prominent Authors on Virtual Leadership Research

Figure 3 presents the total publications (TP) and total citations (TC) of the eminent institutions that are making significant contributions to the field of virtual leadership research. Prominent establishments in the United States are Binghamton University and West Texas University, each of which has had one paper mentioned 421 times. Two other prominent Canadian universities with one publication and two hundred and thirty-six citations each are the University of Calgary and the University of Western Ontario. Each of the two UK universities, University of Reading and University of West England, has one article with 209 citations. Universities such as the University of Southern California in the United States, the Lego Group in Denmark, and Aalborg University in Denmark have all contributed with one article and around 208 citations. With two publications and 203 citations, Northwestern University in the USA stands out. Other notable universities that have made substantial contributions include the National University of Ireland and the University of Crete in Greece, with two publications and 153 and 143 citations, respectively. This information highlights these organizations' significant academic contributions and impact on the development of virtual leadership.

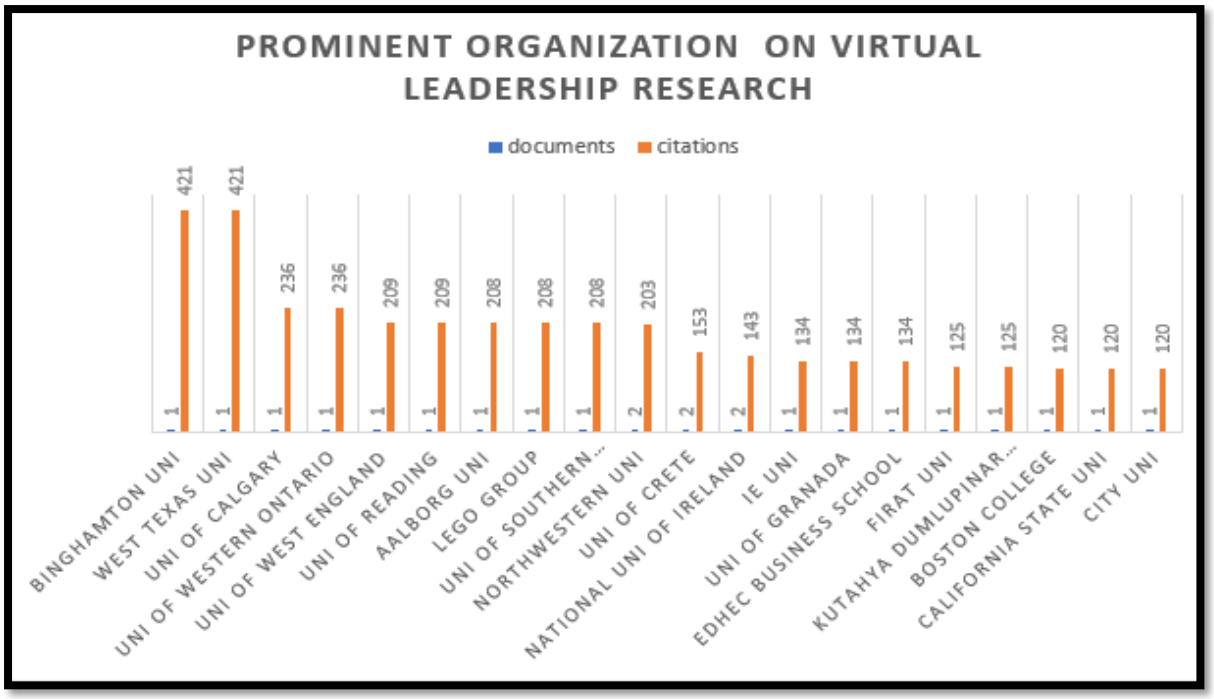

Figure 3: Prominent organisation in virtual leadership research

The leading nations in the field of virtual leadership research are displayed in Figure 4, along with a summary of their total publications (TP) and total citations (TC). With 33 publications and 1473 citations, the United States tops the world in research presence. Following with 13 publications and 484 citations is the United Kingdom. Notable include South Korea with 9 articles and 361 citations, and Hong Kong with 7 publications and 380 citations. Indonesia is noteworthy as well, with 330 citations and 30 articles. Canada, with 7 articles and 354 citations, Turkey, with 10 publications and 332 citations, and France, with 7 publications and 229 citations, are among the other noteworthy contributors. China and India each have 15 publications to their credit; China has 211 citations while India has 96. With 11 papers and 170 citations, and 14 publications and 97 citations, respectively, Germany and Malaysia also make noteworthy contributions. This information demonstrates how research is distributed around the world and how these nations have significantly advanced the subject of virtual leadership.

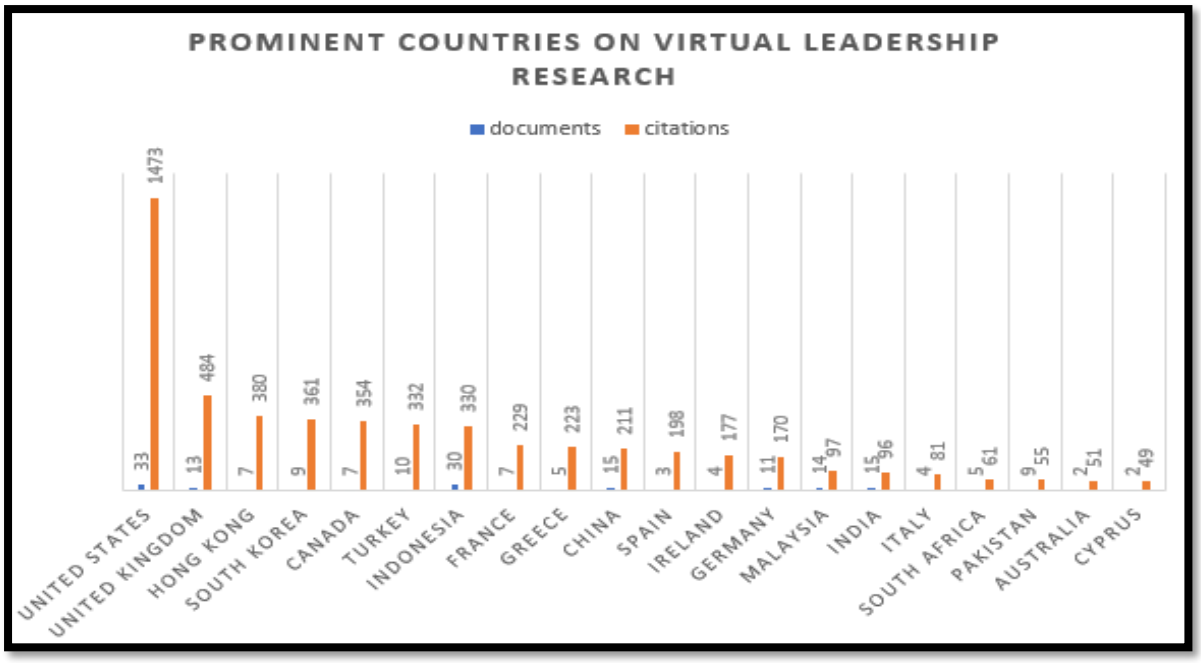

Figure 4: Prominent Countries in Virtual Leadership Research

Most Influential Journals (MIJ) on Virtual Leadership

In the area of virtual leadership, Table 3 lists the most influential journals (MIJ) along with a breakdown of their total publications (TP) and total citations (TC) for the years 2000–2010, 2011–2020, and 2021–2024. Mostly from 2000 to 2010, "Organizational Dynamics" leads with 4 publications and 602 citations. "Leadership Quarterly" has made substantial contributions in the years 2000–2010 and 2021–2024, with 3 publications and 432 citations. Particularly noteworthy are the 10 publications and 287 citations for "Sustainability (Switzerland)" from 2021–2024. With five publications and 183 citations, the "British Journal of Educational Technology" mostly covers the years 2011–2020. Other renowned journals are "Technology in Society," which has two publications from 2021–2024, and "Management Science Letters," which has three publications from 2011–2020. This data demonstrates the wide range of journals that have contributed to the subject, each having a different impact on citations and a different time of influence.

Table 3
Most Influential Journals (MIJ) in Virtual Leadership

Journal	TP	TC	2000-2010	2011-2020	2021-2024
Organizational Dynamics	4	602	4	-	-
Leadership Quarterly	3	432	1	-	2
Sustainability (Switzerland)	10	287	-	-	10
Organizational Behavior and Human Decision Processes	1	236	1	-	-
Journal of Information Technology	1	209	-	1	-
Mis Quarterly Executive	1	208	-	1	-
British Journal of Educational Technology	5	183	-	5	-
Management Science Letters	3	146	-	3	-
Information and Management	1	134	-	-	1
International Review of Administrative Sciences	1	120	-	-	1
Mit Sloan Management Review	1	120	-	1	-
Public Administration Review	1	103	-	1	-
Technology In Society	2	98	-	-	2
Developmental Psychology	1	83	1	-	-
International Journal of Learning, Teaching and Educational Research	4	82	-	3	1
Journal of Asian Finance, Economics and Business	1	70	-	1	-
Journal of Leadership and Organizational Studies	2	70	-	1	1
Leadership and Organization Development Journal	2	65	-	2	-
Group Decision and Negotiation	1	64	1	-	-
Educational Management Administration and Leadership	2	63	-	1	1

Most Influential Articles (MIA) on Virtual Leadership

The most influential articles (MIA) on virtual leadership are included in Table 4, which also includes information about the article's title, total citations (TC), and author(s). Below is a paragraph-by-paragraph explanation: A number of seminal works that have received a great deal of scholarly attention and contributed significant new insights have had a major impact on the area of virtual leadership. With 421 citations, the influential paper "E-leadership: Implications for theory, research, and practice" by Avolio from 2000 stands out since it lays the theoretical groundwork and offers useful implications for e-leadership. Subsequently, Hambley's 2007 study "Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes" has garnered 236 citations, highlighting the significance of communication channels and leadership styles in virtual teams.

The 2003 study "E-leadership and virtual teams" by Cascio, which delves deeper into the dynamics of virtual teams, has also garnered significant attention with 218 citations. Li's 2016 empirical study, which has received 209 citations, has also been helpful in highlighting the strategic dimensions of e-leadership. It focuses on "e-Leadership through strategic alignment"

in small- and medium-sized firms. 208 citations have been made to Sawy's 2016 essay about LEGO's digital leadership capabilities and foundations, which provides business examples of digital leadership. The 2003 paper "Adding the 'E' to E-leadership: How it may impact your leadership" by Ovolio, which discusses incorporating electronic components into traditional leadership, has 204 citations. With an emphasis on maximizing the advantages and reducing the disadvantages of virtual teams, Zaccaro's 2003 work on the difficulties of leading e-teams has received 169 citations. With 134 and 125 citations, respectively, more recent research such as Benitez's 2022 paper on the effect of digital leadership on innovation performance and Karakose's 2021 investigation of digital leadership during the COVID-19 pandemic have also had a significant influence.

Other notable publications are Van Wart's (2019) operationalization of e-leadership definitions and Kane's (2019) exploration of the uniqueness of digital leadership, both with 120 citations. With 103 citations, Roman's 2019 investigation on e-leadership competency in ICT-mediated communications is likewise noteworthy. Moreover, Borah's 2022 correlation of digital leadership, social media usage, and SME performance has been referenced 92 times, highlighting the significance of digital leadership in modern corporate operations. Furthermore, with 83, 82, and 70 citations, respectively, Cassell's 2006 study on the language of online leadership, Mihardjo's 2019 research on the effect of digital leadership on dynamic capability, and Wolor's 2020 investigation into e-training and e-leadership during COVID-19 have all contributed insightful findings. Citations ranging from 54 to 64 have contributed to the field's enrichment: Neufeld's 2010 paper on distant leadership, Díaz-Gibson's 2017 study on networked leadership in educational networks, and Darics's 2020 work on nonverbal communication in e-leadership. Last but not least, Narbona's 2016 paper—which has 54 citations—on digital leadership and Pope Francis's usage of Twitter offers a distinct viewpoint. Together, these papers demonstrate how varied and dynamic the field of virtual leadership study is. Table 4 shows the twenty most influential articles in the field of virtual leadership.

Table 4
The Most Influential Articles (MIA) on Virtual Leadership

Author(s)	Title	TC
Avolio (2000)	“E-leadership: Implications for theory, research, and practice”	421
Hambley (2007)	“Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes”	236
Cascio (2003)	“E-leadership and virtual teams”	218
Li (2016)	“e-Leadership through strategic alignment: An empirical study of small- and medium-sized enterprises in the digital age”	209
Sawy (2016)	“How LEGO built the foundations and enterprise capabilities for digital leadership”	208
Ovolio (2003)	“Adding the "E" to E-leadership: Hot it may impact your leadership”	204
Zaccaro (2003)	“E-leadership and the challeges of leading E-Teams: Minimizing the bad and miximizing the good”	169
Benitez (2022)	“Impact of digital leadership capability on innovation performance: The role of platform digitization capability”	134

Karakose (2021)	"Examining teachers' perspectives on school principals' digital leadership roles and technology capabilities during the covid-19 pandemic"	125
Kane (2019)	"How digital leadership is(n't) different"	120
Van Wart (2019)	"Operationalizing the definition of e-leadership: identifying the elements of e-leadership"	120
Roman (2019)	"Defining E-leadership as Competence in ICT-Mediated Communications: An Exploratory Assessment"	103
Borah (2022)	"Linking social media usage and SME's sustainable performance: The role of digital leadership and innovation capabilities"	92
Cassell (2006)	"The language of online leadership: Gender and youth Engagement on the Internet"	83
Mihardjo (2019)	"Digital leadership impacts on developing dynamic capability and strategic alliance based on market orientation "	82
Wolor (2020)	"Effectiveness of E-Training, E-Leadership, and Work Life Balance on Employee Performance during COVID-19"	70
Neufeld (2010)	"Remote leadership, communication effectiveness and leader performance"	64
Díaz-Gibson (2017)	"Networked leadership in Educational Collaborative Networks"	62
Darics (2020)	"E-Leadership or "How to Be Boss in Instant Messaging?" The Role of Nonverbal Communication"	54
Narbona (2016)	"Digital leadership, Twitter and Pope Francis"	54
Note(s): TC = total citations		

Science Mapping

Science mapping looks at the connections among the many research components. The conceptual and structural relationships between research participants are the main focus of the analysis (Baker et al., 2021; Donthu et al., 2021). Citation analysis, co-citation analysis, bibliographic coupling, co-word analysis, and co-authorship analysis are some of the methods used in science mapping. These methods are essential for shedding light on the bibliometric and intellectual structures of the field when paired with network analysis (Tunger & Eulerich, 2018; Baker et al., 2020; Donthu et al., 2021). This study will employ bibliographic coupling, co-occurrence bibliometrics, and co-citation analysis.

Thematic and Influence Structure Analysis through Bibliographic Coupling

Table 5 uses bibliographic coupling to present the virtual leadership subject clusters research. E-Leadership, Digital Leadership Capability, Sustainable Performance, Mediated Communications are the four theme groupings. Table 5 also displays the articles that have the biggest impact on each cluster.

- **Cluster 1: E-Leadership**

The foundational works on the core concepts of e-leadership are included in this cluster. The 2000 paper "E-leadership: Implications for theory, research, and practice" by Avolio stands significant because it has 421 citations, which lays the foundation for the implications in theory and practice. The impact of communication media and leadership styles is examined in Hambley's 2007 study, "Virtual team leadership: The effects of leadership style and

communication medium on team interaction styles and outcomes," which has 236 citations. The articles "Remote leadership, communication effectiveness and leader performance" by Neufeld (2010) and "E-Leadership or 'How to Be Boss in Instant Messaging?'" by Darics (2020) both have 64 citations. The Importance of Nonverbal Communication" (54 citations) delves deeper into the subtleties of e-leadership, emphasizing nonverbal indicators and communication efficacy in online environments.

- **Cluster 2: Digital Leadership Capability**

The competencies necessary for successful digital leadership are the main emphasis of this cluster. With 134 citations, Benitez's 2022 paper "Impact of digital leadership capability on innovation performance: The role of platform digitization capability" emphasizes how crucial digital leadership is to fostering innovation. Li's (2016) research on strategic alignment in digital leadership is titled "e-Leadership through strategic alignment: An empirical study of small- and medium-sized enterprises in the digital age" (209 citations). The impact of digital leadership on building dynamic capabilities and strategic alliances based on market orientation is covered in Mihardjo's 2019 essay "Digital leadership impacts on developing dynamic capability and strategic alliance based on market orientation" (82 citations).

- **Cluster 3: Sustainable Performance**

Studies that connect digital leadership to sustainable performance are included in this cluster. With 92 citations, Borah's 2022 paper "Linking social media usage and SME's sustainable performance: The role of digital leadership and innovation capabilities" highlights the contribution of both social media and digital leadership to sustainable output. Digital leadership in the educational sector during the pandemic is examined in Karakose's 2021 study, "Examining teachers' perspectives on school principals' digital leadership roles and technology capabilities during the COVID-19 pandemic" (125 citations). A distinctive viewpoint on digital leadership via social media may be found in Narbona's 2016 work "Digital leadership, Twitter and Pope Francis" (54 citations).

- **Cluster 4: Mediated Communications**

The function of mediated communications in e-leadership is the main topic of this cluster. The 83-citation paper "The language of online leadership: Gender and youth engagement on the Internet" by Cassell (2006) explores the language used in online leadership. E-leadership competencies in ICT-mediated communications are examined in Roman's 2019 paper, "Defining E-leadership as Competence in ICT-Mediated Communications: An Exploratory Assessment" (103 citations). Determining the essential components of e-leadership is the goal of Van Wart's 2019 paper, "Operationalizing the definition of e-leadership: identifying the elements of e-leadership" (120 citations). These clusters, which showcase important themes and significant studies in the area, collectively reflect the varied and multidimensional character of virtual leadership study.

Table 5
Thematic Clusters of Virtual Leadership

Theme	Author(s)	Title	TC
Cluster-1 E-Leadership	Avolio (2000)	E-leadership: Implications for theory, research, and practice	421
	Darics (2020)	E-Leadership or "How to Be Boss in Instant Messaging?" The Role of Nonverbal Communication	54
	Hambley (2007)	Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes	236
	Neufeld (2010)	Remote leadership, communication effectiveness and leader performance	64
Cluster-2 Digital Leadership Capability	Benitez (2022)	Impact of digital leadership capability on innovation performance: The role of platform digitization capability	134
	Li (2016)	e-Leadership through strategic alignment: An empirical study of small- and medium-sized enterprises in the digital age	209
	Mihardjo (2019)	Digital leadership impacts on developing dynamic capability and strategic alliance based on market orientation	82
Cluster -3 Sustainable Performance	Borah (2022)	Linking social media usage and SME's sustainable performance: The role of digital leadership and innovation capabilities	92
	Karakose (2021)	Examining teachers' perspectives on school principals' digital leadership roles and technology capabilities during the covid-19 pandemic	125
	Narbona (2016)	Digital leadership, Twitter and Pope Francis	54
Cluster-4 Mediated Communications	Cassell (2006)	The language of online leadership: Gender and youth Engagement on the Internet.	83
	Roman (2019)	Defining E-leadership as Competence in ICT-Mediated Communications: An Exploratory Assessment	103
	Van Wart (2019)	Operationalizing the definition of e-leadership: identifying the elements of e-leadership	120

Note(s): TC = total citations

Thematic Trends of Virtual Leadership through Co-Occurrence Analysis by Authors' Keywords
We employ co-occurrence analysis to look at thematic patterns in virtual leadership research, building on the frameworks and topics provided by co-citation analysis and bibliographic coupling. Keywords from the authors are used in co-occurrence analysis. These keywords are then run through a temporal filter in order to identify the thematic evolution of virtual team research issue concerns that show up in at least three articles within our review corpus. The primary subjects that were covered in earlier research on virtual leadership—such as digital leadership, E-leadership, leadership, digital transformation, virtual teams, and others—are depicted in Figure 5. These subjects are most prevalent between 2000 and 2024.

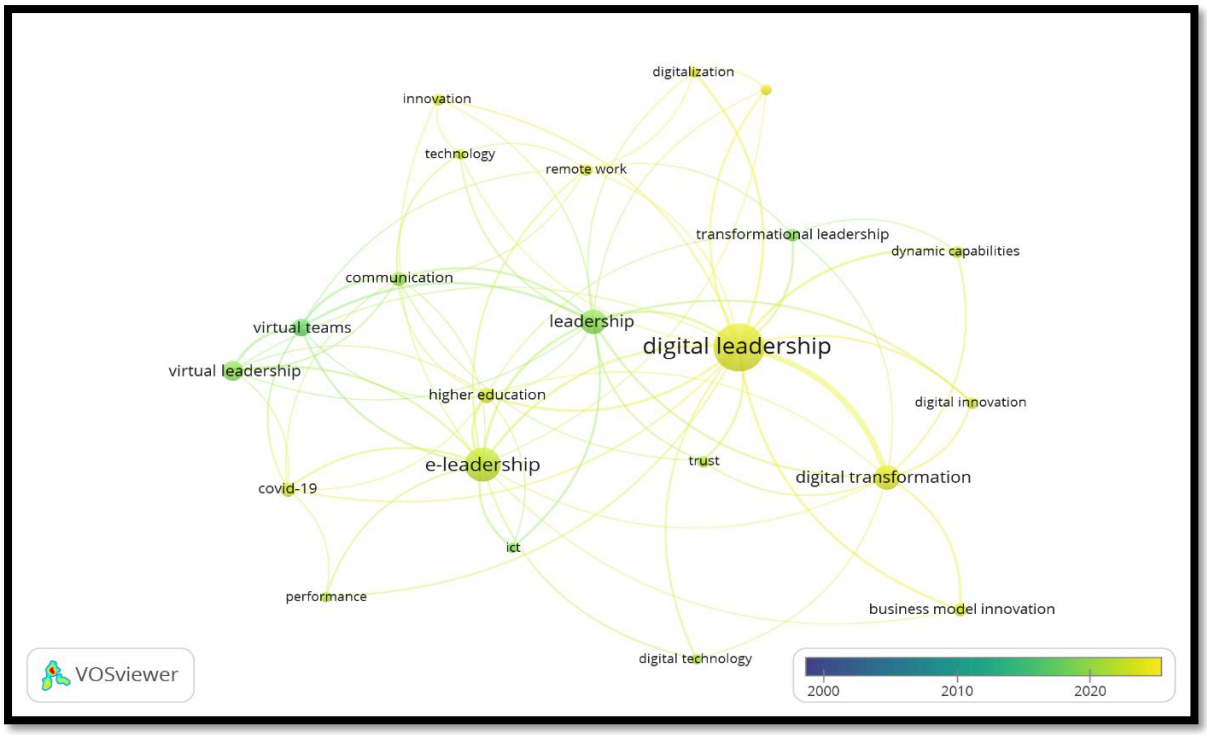

Figure 5: Influential topics in the “period of 2000–2024”

Future Research Directions of Virtual Leadership

The "Future Research Directions on Virtual Leadership" chart shows the frequencies of the different study themes. Digital leadership (84 occurrences) and leadership (42 occurrences) are the most prevalent themes that have been identified for future research, suggesting a strong focus in these areas. The next three categories show a great deal of interest in the ways that digital and transformational leadership practices are developing, particularly in virtual team environments: digital leadership (23 occurrences), transformation (22 occurrences), and virtual teams (14 occurrences).

Notable occurrences include Higher Education (12 instances) and Communication (9 instances), indicating the need to investigate virtual leadership in educational settings and communication tactics. The eight instances of business models and innovation, the seven instances of digital transformation, and the six instances of digital capability emphasize how critical it is to comprehend how virtual leadership affects business innovation and transformation.

Furthermore, themes with four to five occurrences each, such as Ambidexterity, Innovation, Remote Work, Trust, Digitalization, ICT, Performance, and Technology, indicate new directions for virtual leadership research. Together, these themes point to a wide range of areas that warrant further investigation, highlighting the dynamic and complex character of virtual leadership in modern environments. Figure 6 shows future directions for virtual driving research.

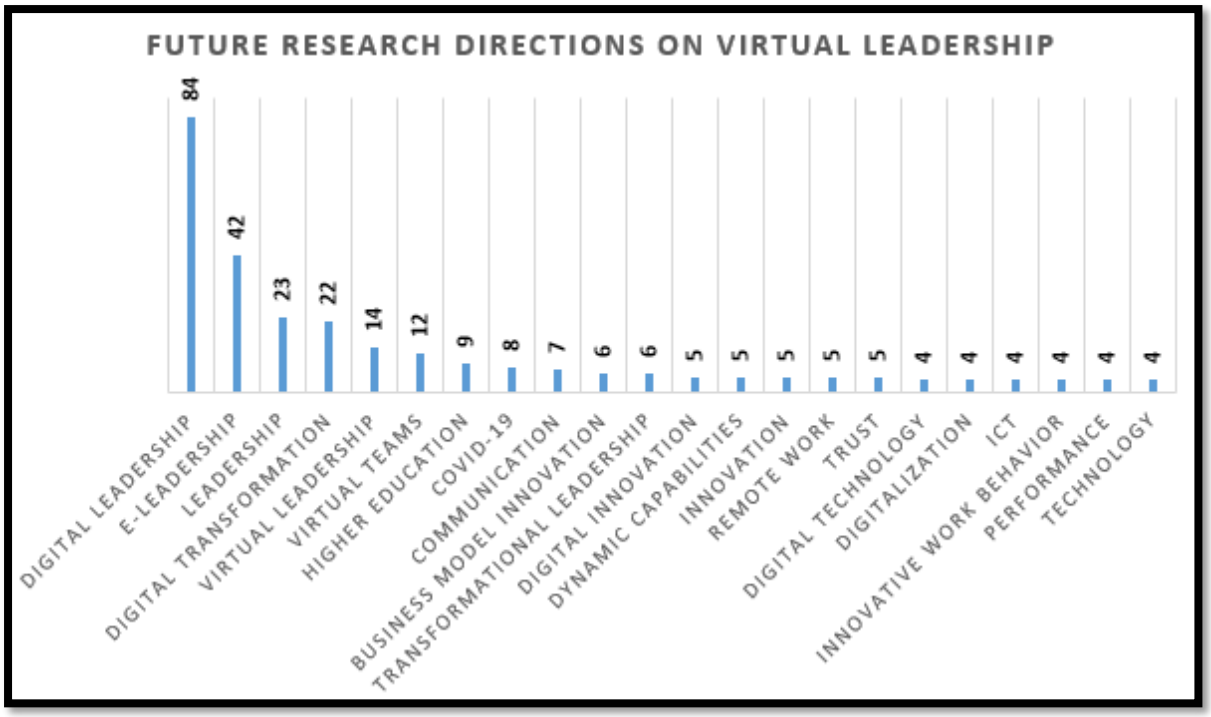

Figure 6: Future Research Directions on Virtual Leadership

Conclusion

The study aims to identify global research trends and future prospects for virtual leadership research during the last three decades (2000–2024) using bibliometric analysis. Using data from 199 publications on virtual leadership that were taken from the Scopus database (2 July 2024), the study uses bibliometric analysis to look at co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation analysis. It uses scientific mapping and performance analysis to do this. Along with the quantity of scientific publications, the most prolific writers, important articles, nations, and organizations were also looked at. VOSviewer was utilized in the research as a tool for science mapping and performance analysis.

With 41 articles, the years 2023 and 2024 were the most productive, and the United States and Binghamton University were the two nations with the greatest influence, respectively. Similarly, "Organizational Dynamics" is the most influential publication, while "E-leadership: Implications for theory, research, and practice" is the most cited article. The authors also distinguished four research themes related to virtual leadership: mediated communications, sustainable performance, digital leadership capability, and e-leadership. This study offers academics recommendations and information about the state of the research in the field of virtual leadership literature. It also recommends directions for further research in this area of study. This research advances our knowledge of virtual leadership science mapping and performance analysis.

Theoretical contributions

In a number of respects, the current study significantly advances the field of virtual leadership theoretically. First, by means of bibliometric analysis and scientific mapping, it improves our comprehension of worldwide research trends and prospects in virtual leadership going forward. In addition, it offers a thorough categorization of study by highlighting the most

productive writers, noteworthy publications, and powerful nations and organizations, helping to direct future investigations. Third, by providing a cogent theoretical framework for comprehending and advancing this discipline, it highlights four primary research themes in virtual leadership: mediated communications, sustainable performance, digital leadership competence, and e-leadership. Finally, it offers insightful suggestions and prospective study avenues that point scholars in the direction of the most significant and influential avenues in virtual leadership, expanding knowledge and theory in this rapidly expanding field.

Limitations

Here are some possible limitations of the current study on virtual leadership research, based on the results of the current study provided: Limitations of Data Sources: First: Only papers that are indexed in the Scopus database are used in this study. This could limit the analysis's comprehensiveness by excluding pertinent research that is not indexed or published in other databases. second: Themes' Range: The study outlines four research themes; nevertheless, it's possible that these themes don't fully address every facet of virtual leadership, leaving out newer or less studied subjects. By addressing these issues, future bibliometric analyses in the field of virtual leadership research may be more reliable and applicable.

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